

# Geometrically Inspired Kernel Machines for Collaborative Learning Beyond Gradient Descent (Abstract Reprint)

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## Abstract

This paper develops a novel mathematical framework for collaborative learning by means of geometrically inspired kernel machines which includes statements on the bounds of generalisation and approximation errors, and sample complexity. For classification problems, this approach allows us to learn bounded geometric structures around given data points and hence solve the global model learning problem in an efficient way by exploiting convexity properties of the related optimisation problem in a Reproducing Kernel Hilbert Space (RKHS). In this way, we can reduce classification problems to determining the closest bounded geometric structure from a given data point. Further advantages that come with our solution is that our approach does not require clients to perform multiple epochs of local optimisation using stochastic gradient descent, nor require rounds of communication between client/server for optimising the global model. We highlight that numerous experiments have shown that the proposed method is a competitive alternative to the state-of-the-art.

## References

Kumar, M.; Valentinitisch, A.; Fuchs, M.; Brucker, M.; Bowles, J.; Husakovic, A.; Abbas, A.; and Moser, B. A. 2025. Geometrically Inspired Kernel Machines for Collaborative Learning Beyond Gradient Descent. *Journal of Artificial Intelligence Research*, 83: 16:1–16:35.